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April 1992

AIR TRAFFIC CONTROL

Status of FAA's Modernization Program

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Resources, Community, and
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April 3, 1992

The Honorable Frank R. Lautenberg
Chairman
The Honorable Alfonse M. D'Amato
Ranking Minority Member
Subcommittee on Transportation
and Related Agencies
Committee on Appropriations
United States Senate

The Honorable William Lehman
Chairman
The Honorable Lawrence Coughlin
Ranking Minority Member
Subcommittee on Transportation
and Related Agencies
Committee on Appropriations
House of Representatives

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This responds to your request for information on the Federal Aviation Administration's (FAA) air traffic control (ATC) modernization program. This program is aimed at modernizing the current ATC system to permit continued safe and efficient air travel. It consists primarily of acquisitions to modernize ATC, including radars, computers, and communications networks. ATC modernization is funded largely through FAA's Facilities and Equipment (F&E) appropriations. The F&E appropriation has increased almost 10-fold, from about $260 million in fiscal year 1982 to almost $2.4 billion in 1992. FAA is seeking $2.7 billion in its fiscal year 1993 request, a 13-percent increase over the fiscal year 1992 appropriation.

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The ATC modernization program, known from its inception in 1981 until 1989 as the National Airspace System (NAS) Plan, is now known as the Aviation System Capital Investment Plan (CIP). The 1991 CIP incorporates projects from the original NAS Plan that are incomplete, plus about 150 additional projects. To assist your review of the fiscal year 1993 F&E budget and your continued oversight of the CIP, this briefing report provides cost and schedule information on the CIP as a whole as well as on specific projects within that plan.

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In summary, we found that:

-- CIP costs continue to escalate. FAA estimated, as of October 1991, that projects in its 1991 CIP will require $31.9 billion through the year 2000--more than one-half billion dollars over the previous year's estimate. The majority of this increase is attributable to cost changes in original NAS Plan projects that are still included in the CIP. For fiscal years 1982 through 1992, the Congress has appropriated about $13.4 billion of the $31.9 billion that FAA estimates is needed. Furthermore, FAA continues to experience an upward trend in the unobligated F&E account balance--a 13-percent increase over fiscal year 1991.[1]

-- FAA has completed a total of 36 projects--including 6 completed in 1991. Final field installation (last-site implementation) occurred late for most of these projects. The cost of these 36 projects comprises approximately 3 percent of the total estimated cost of modernization through the year 2000. FAA characterizes only one of the completed 1991 projects as a major acquisition.[2]

-- FAA's $31.9-billion estimate may not recognize all modernization funding needed through the year 2000 because it is based on an ATC consolidation plan that is changing. FAA's current funding estimates are based on the agency's original plan to consolidate over 200 facilities into 23. Under discussion is a plan calling for over 50 facilities. This new plan could require an additional $2.5 billion, including funds for additional

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[1]The Congress appropriates and FAA obligates F&E funds. Obligations involve awarding contracts, placing orders, and receiving services during a given period that will require payments during the same or a future period. The unobligated balances represent appropriated funds not yet obligated.

[2]A major acquisition is generally a project whose total costs exceed $50 million. The New York Terminal Radar Approach Control facility was the only major acquisition completed in 1991.

buildings and ATC equipment such as computers and communication systems.

-- Of the 12 major projects that we reviewed in detail, 10 experienced either cost increases or schedule delays since last year. Four of the 12 had both cost increases and schedule delays. Three projects had only cost increases, and another three had only implementation delays since last year. The progress of these 12 projects is important because they represent 33 percent of FAA's F&E budget estimate and are expected to contribute 57 percent of the benefits that FAA believes will accrue from modernization.[3] The most recent estimates show that these projects incurred cost increases ranging from $13 million to $219.2 million. The $13-million increase was for the purchase of spare parts, the construction of a support facility, and the integration of the Low-Level Wind Shear Alert System with the Terminal Doppler Weather Radar. The Doppler radar's primary purpose is to detect wind shear around airports. The $219.2-million increase was for changes in the requirements of the Advanced Automation System. This project replaces hardware, software, and work stations at air traffic control centers. In comparison with their original 1983 field implementation schedules, 11 of the 12 projects have been delayed, on average, about 5 years.

Our review, conducted from August 1991 through March 1992, focused on changes in the modernization program that have occurred not only during 1991 but also since FAA's 1983 NAS Plan. We have generally used the 1983 NAS Plan to identify program changes, since it represents a more reasonable benchmark for measuring progress than the original 1981 NAS Plan. Section 1 discusses the cost of the overall modernization effort. Specifically, we have (1) compared the costs of all the projects for which FAA has developed F&E estimates, (2) analyzed the ways in which the CIP projects support FAA's air traffic control objectives, and

[3]Benefits include increased safety through collision avoidance systems, improved weather information, reduced delays, and more fuel-efficient routes for system users, such as airlines and airline passengers, as well as increased controller productivity for FAA.

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(3) calculated the delays associated with the original NAS Plan projects. Section 2 details cost and schedule changes since last year and since 1983 for 12 major projects. This section consists of (1) a summary of each project, including a description, a statement of anticipated benefits, a 2-year comparison of total F&E cost estimates, an outline of 1991 key progress and problem issues, and an identification of projects that could be affected by changes in FAA's air traffic consolidation plan; (2) an explanation of our procedure for calculating changes in quantity requirements and for comparing current project cost estimates with initial estimates; and (3) a separate discussion of each project's progress and problems.

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We acquired the information in this report from various sources. Specifically, we obtained (1) information on the overall cost of ATC modernization, as well as on appropriations and obligations, from documents provided by FAA budget officials;[4] (2) cost information on individual systems from FAA's Systems Engineering and Integration Contractor (SEIC) reports and from FAA program officials; and (3) schedule information on individual systems from documents that had been prepared for FAA by SEIC and from interviews with FAA program managers. Because FAA has not yet published its 1991 Aviation System Capital Investment Plan, the agency provided us with a draft version. FAA program officials also provided us with recent cost and schedule data that support the CIP. We obtained other information on the status of the 12 projects that we reviewed in detail, characterized in section 2 as progress and problems, from interviews with FAA program officials and SEIC officials. As agreed with your offices, we provided a draft of this briefing report to officials in FAA's offices of the Associate Administrators for NAS Development and Systems Engineering, as well as FAA's Office of Budget. We also provided a draft to SEIC officials for their review.

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[4]FAA provided the actual or estimated appropriation needs in current or then-year dollars. FAA used the Office of Management and Budget's forecasts to predict the purchasing power of the dollar in future years. The use of current rather than constant dollars limits the comparability of project estimates made at different times.

FAA and SEIC officials generally agreed with the facts as presented. We incorporated their suggested changes as appropriate.

We are providing copies of this briefing report to the Secretary of Transportation; the Administrator, FAA; and other interested parties. We will make copies available to others on request.

If you have any questions about this briefing report, please contact me at (202) 275-1000. Major contributors to this briefing report are listed in appendix II.

Kenneth M. Mead
Director, Transportation Issues

CONTENTS

ABBREVIATIONS

AAS	Advanced Automation System
ARSR-4	Air Route Surveillance Radar-4
ASDE-3	Airport Surface Detection Equipment-3 radar
ASOS	Automated Surface Observing System
ASR-9	Airport Surveillance Radar-9
ATC	Air Traffic Control
AWOS	Automated Weather Observing System
CIP	Capital Investment Plan
CDR	Critical Design Review
CWP	Central Weather Processor
F&E	Facilities and Equipment
FAA	Federal Aviation Administration
FSAS	Flight Service Automation System
GFE	government-furnished equipment
MLS	Microwave Landing System
MWP	Meteorologist Weather Processor
NAS	National Airspace System
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OMB	Office of Management and Budget
RCL	Radio Communications Link
RWP	Real-time Weather Processor
SEIC	Systems Engineering and Integration Contractor
TDWR	Terminal Doppler Weather Radar
VSCS	Voice Switching and Control System

Section 1

INFORMATION ON THE OVERALL STATUS OF MODERNIZATION

The Federal Aviation Administration's (FAA) effort to modernize the air traffic control system has expanded over the last decade from a 10-year, $12-billion program, comprising about 80 projects, into the 1991 CIP, a continuously evolving program.[1] Currently, this 19-year program carries a $31.9-billion price tag for approximately 200 projects. Since we reported in April 1991 on the status of the modernization effort, the program has experienced both cost increases and schedule delays.[2]

TOTAL MODERNIZATION COSTS CONTINUE TO GROW

FAA's October 1991 financial plan estimates that the modernization program will require $31.9 billion in Facilities and Equipment (F&E) appropriations through fiscal year 2000. This plan identifies costs associated with the projects listed in the draft 1991 CIP. Although FAA recently deleted the $562-million National Airspace Management Facility project, it has not revised its financial plan to identify cost increases or decreases in other CIP projects. In addition, we found that about half of this $562-million decrease will probably be offset by cost increases associated with the 12 major acquisitions that we review in detail in section 2.

FAA's October 1991 estimate has increased by $614 million over last year's estimate of $31.3 billion. This increase consists of (1) $420 million in additional costs for original NAS Plan projects, (2) $125 million for new 1991 CIP projects, and (3) $69 million for other projects added since the original NAS Plan and before the 1991 CIP. However, this $31.9-billion cost estimate does not include all the costs associated with projects whose implementation date extends beyond the year 2000--such as the Microwave Landing System (MLS). Of the total $31.9 billion that FAA now estimates the program will require, the Congress has appropriated about $13.4 billion through fiscal year 1992.

We also compared the costs of all the projects for which FAA has developed F&E estimates through the year 2000 (see app. I).

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[1]According to FAA's former Administrator--in contrast to the original NAS Plan--the CIP and the number of projects in it will continue to grow as aviation system needs change. However, for financial planning purposes, FAA tracks its costs from fiscal year 1982 through fiscal year 2000.

[2]Air Traffic Control: Status of FAA's Modernization Effort (GAO/RCED-91-132FS, Apr. 15, 1991).

Specifically, we compared FAA's F&E financial plan for projects in the 1983 NAS Plan, the 1990 CIP, and the 1991 CIPs. For 32 of the 80 projects in the 1983 NAS Plan, or about 40 percent, costs have increased.[3] For 57 out of the roughly 200 ongoing projects described in both the 1990 and 1991 CIPs, costs through the year 2000 have increased, and for 59 projects, costs have decreased. Increases between 1990 and 1991 ranged from about $0.2 million to about $500 million, and decreases ranged from about $0.1 million to $138.5 million.

For example, between 1990 and 1991, the largest increase in a project's cost estimate was for the Voice Switching and Control System (VSCS) project. This project replaces and improves voice ground-to-ground and air-to-ground communications at air traffic control facilities. As we reported last year, this project's cost increased by $507.4 million--from $892.4 million to $1,399.8 million through the year 2000. The VSCS increase was due primarily to additional requirements for design and development work to bring the VSCS prototype into compliance with FAA requirements. As we explain in section 2 of this briefing report, project officials expect the VSCS cost estimate to remain the same for 1992.

The largest decrease between 1990 and 1991 is associated with MLS--Phases I and II combined. This project provides electronic guidance to aircraft for precision approaches and landings. FAA's estimate of the project's cost through the year 2000 decreased from 1990 to 1991 by $194.1 million--from $1,573.1 million to $1,379.0 million. However, as we explain in section 2 of this briefing report, project officials estimate in 1992 that the total MLS project will ultimately cost $2,623.7 million--a difference of $1,244.7 million. According to project officials this difference consists largely of MLS costs beyond the year 2000. Although last-site implementation for MLS is scheduled for 2008, FAA's current F&E financial plan does not identify MLS funding requirements beyond the year 2000.

MAINTENANCE AND OPERATIONS PROJECTS INCUR LARGEST COST GROWTH

The 1991 CIP categorizes each project according to one of six major parts of the ATC system that the project is designed to improve. The ATC system manages the entire course of all aircraft flying under "instrument flight rules." These aircraft account for virtually all scheduled airline flights. The ATC segments that the

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[3]FAA's October 1991 F&E financial plan includes projected costs that may differ slightly from the estimates we have used elsewhere in this report. Where differences exist, the program manager, who serves as the primary point of accountability to FAA's Administrator, has provided an estimate that has been updated since the 1991 F&E financial plan was prepared.

CIP projects are designed to improve are en route airspace, terminal airspace, flight service and weather information, ground-to-air facilities and equipment, interfacility communications, and maintenance and operations support.

-- En route projects affect the control of the aircraft in flight, i.e., between takeoff and landing.

-- Terminal projects affect aircraft approaches, landings, takeoffs, and departures from airports.

-- Flight service and weather projects provide vital information to pilots about conditions and requirements along the route that the pilots will follow.

-- Ground-to-air projects provide the facilities and equipment on the ground that support communication, navigation, landing, and the surveillance of aircraft in flight.

-- Interfacility communication projects allow FAA facilities on the ground to communicate with one another.

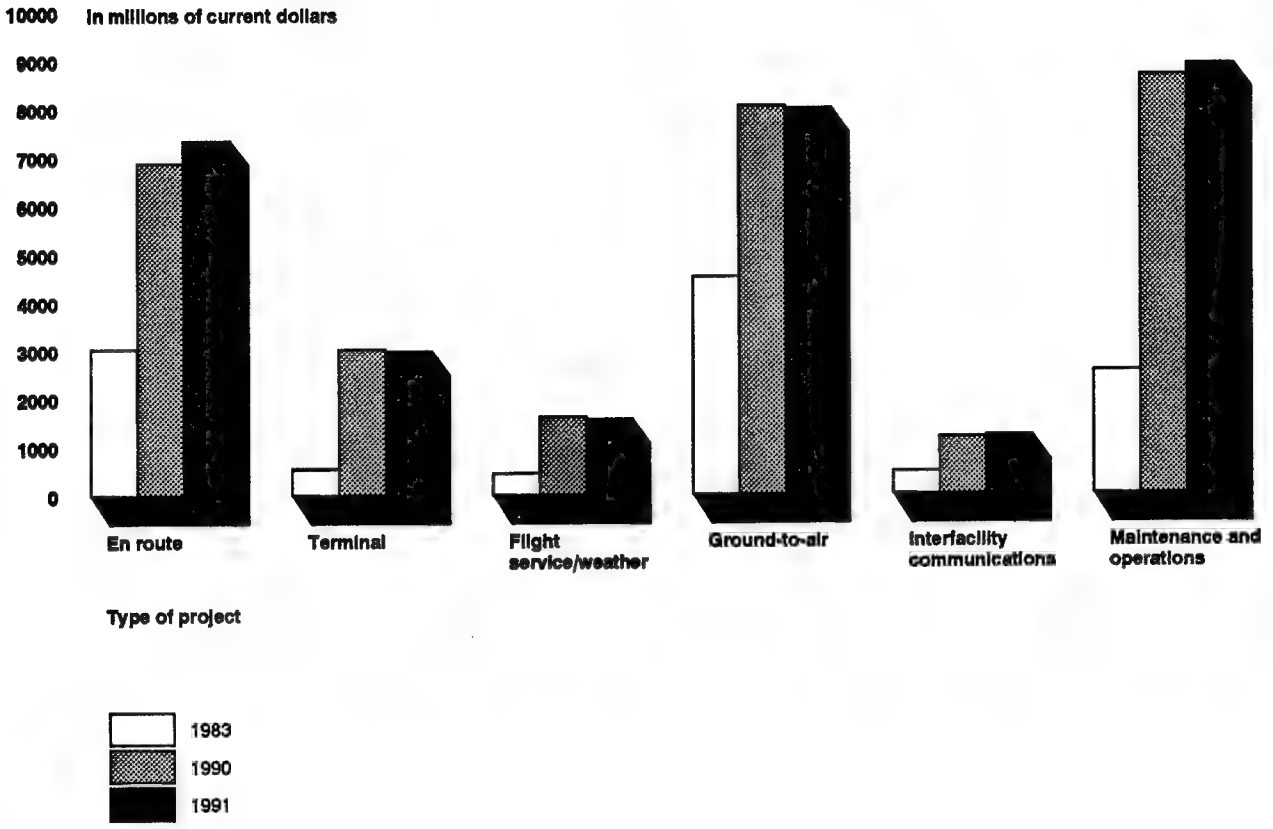
-- Maintenance and operations support projects provide the facilities and equipment needed to ensure that the system is well maintained.

We evaluated the 1983 NAS Plan and the 1990 and 1991 CIPs to determine how FAA is identifying its F&E modernization funding needs for the six major ATC segments. Our analysis shows that between 1983 and 1991, costs for maintenance and operations projects have increased by the largest amount--$6.4 billion. Costs for en route projects have grown by the second largest amount--$4.3 billion--and costs for interfacility communication projects have exhibited the smallest increase--$731 million.

Since last year, estimated funding needs for maintenance and operations projects and en route projects grew by $218 million and $467 million, respectively. During this period, funding estimates for terminal projects decreased by $39 million. Increases in estimates of maintenance and operations costs, both since 1983 and between 1990 and 1991, reflect the costs of additional activities undertaken because of delays in implementing modernization projects associated with, for example, the Advanced Automation System (AAS). The increased cost estimates for en route projects occurred primarily because of cost increases associated with AAS and VSCS. FAA officials said that the reduced funding estimate for terminal projects reflected the removal of the New Austin Airport project from the 1991 CIP and a reduction in the cost of the Terminal Voice Switch Replacement project.

Figure 1.1 compares the 1983, 1990, and 1991 funding estimates for the CIP projects that support each major part of the ATC system.

Figure 1.1: FAA's F&E Funding Estimates for Major Parts of the ATC System



Source: GAO analysis of FAA data.

FAA ADDS FIVE PROJECTS AND COMPLETES SIX IN 1991

FAA added five projects to the 1991 CIP--dramatically fewer than the 94 projects that FAA added to the 1990 CIP. According to FAA, the five projects will cost $125 million, or an average of $25 million each, through the year 2000. The estimated funding needed for these projects ranges from $8 million to $62 million. Of the five new projects, two address ATC maintenance and operations needs, and one each addresses en route airspace, terminal airspace, and ground-to-air facility and equipment needs.

One measure of FAA's progress in modernization is the number of projects that have achieved last-site implementation. FAA has fully implemented 36 projects in the field--6 in the past year. None of the six completed in 1991 achieved last-site implementation on schedule. The six most recently completed projects attained last-site implementation, on average, 4 years later than initially specified in the NAS Plan.

The 36 completed projects cost about $900 million, or approximately 3 percent of the total estimated cost of FAA's ATC modernization effort through fiscal year 2000. The remaining 97 percent of the modernization effort includes the most costly projects. For example, the 1992 cost estimate for the Advanced Automation System is $4,672.9 million, and for the Microwave Landing System $2,623.7 million. Last-site implementation dates for these projects are 2001 and 2008, respectively. The first- and last-site implementation dates for both projects have remained unchanged from last year.

UNOBLIGATED F&E BALANCES CONTINUE UPWARD TREND

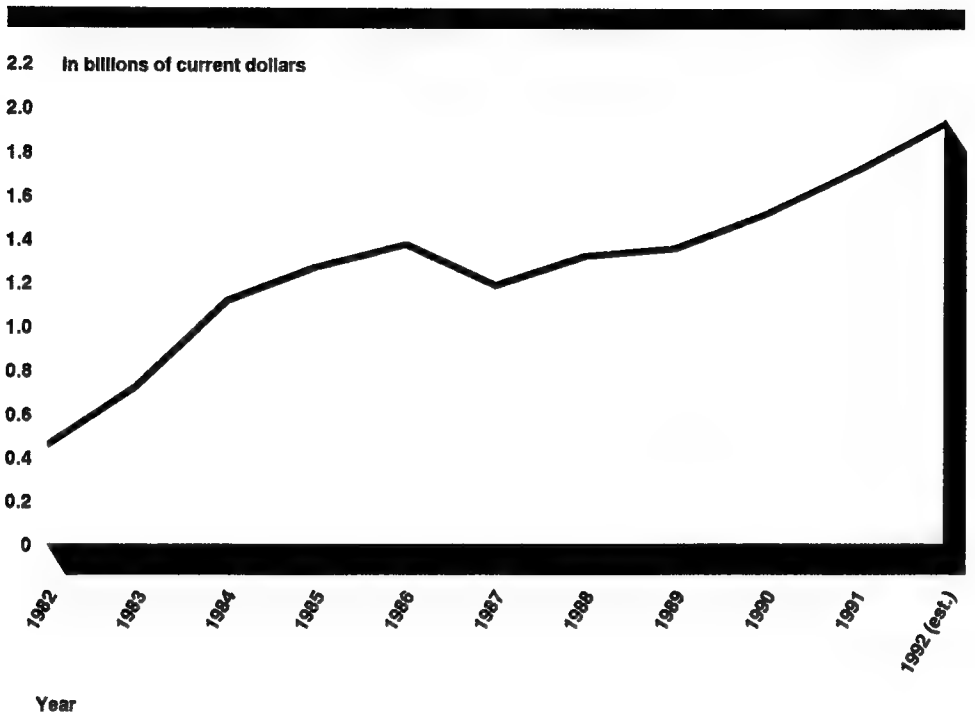
The progress of the ATC modernization program can also be measured by comparing the amount of F&E funding that the Congress has appropriated with the amount that FAA has obligated. Obligations involve awarding contracts, placing orders, and receiving services during a given period that will require payments during the same or a future period. Figure 1.2 shows that FAA's unobligated F&E balances continue to grow. As we reported last year, the Congress considers the growth in FAA's F&E unobligated balance a sign of weaknesses in financial and program management as well as a result of delays in planned acquisition schedules. To instill more management discipline, the Congress, in Public Law 102-143, decreased from 5 years to 3 years the time that FAA has to obligate the majority of its fiscal year 1992 F&E funding.

According to FAA, the unobligated balances have continued to grow through fiscal year 1991 for two reasons. First, agency officials said that about 20 percent of the total unobligated balance can be attributed to project slippages. When projects are not started on schedule, contract awards are delayed and funds are obligated later than planned. Second, unobligated balances have resulted from multiple-year budget authority, which makes appropriations available for obligation for up to 5 years.

FAA believes that the unobligated balances will decrease dramatically starting in fiscal year 1994 because (1) FAA's appropriations level will begin to decrease, (2) the NAS Plan projects requiring the largest obligations are now under contract, and (3) new CIP projects will be relatively small and not

contracted for on a full-funding basis.[4] Figure 1.2 shows FAA's unobligated balances for the past 11 years.

Figure 1.2: Unobligated Balances Continue to Increase



Source: GAO analysis of FAA data.

SCHEDULE DELAYS DEFER BENEFITS FOR USERS

Fifty-six of the 80 projects in the 1983 NAS Plan should have achieved their last-site implementation by the end of calendar year 1991; 28 did. FAA has indicated that six of these delayed projects are expected to generate the majority of the benefits for users. Delays in these six projects will defer a substantial portion of the $258 billion in benefits that FAA estimates these projects will provide for ATC system users.[5]

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[4]Under FAA's full funding concept, all moneys needed to procure and install a given number of projects are requested in the first year. The funds the Congress appropriates are then available for obligation until the designated number of years in the multiple-year budget authority have elapsed.

[5]In constant 1991 dollars.

The six projects that FAA identified are the (1) Advanced Automation System (AAS), (2) Automated En Route Air Traffic Control, (3) Voice Switching and Control System (VSCS), (4) Mode Select (Mode S) Radar, (5) Central Weather Processor (CWP), and (6) Microwave Landing System (MLS), including the associated improvements in air traffic management. Delays in last-site implementation for these six projects have ranged from 3 years for the Mode S project to 9 years for the MLS project. Mode S delays have postponed FAA's plans to substitute automatic weather and air traffic communications with pilots for voice communications with controllers. Such automatic communications would help to reduce controllers' work load. However, almost 8 years after the signing of the production contract, FAA does not have a working Mode S. First-site implementation of Mode S is now scheduled for 1993 and last-site implementation for 1996.

Because very few projects have been completed and project delays continue, the slowed acquisitions schedules continue to create the same problems that we reported in November 1988,[6] including

-- unrealized gains in FAA work force productivity,

-- a growing demand for service in the commercial aviation industry without simultaneous improvement in the effectiveness of the air traffic control system, and

-- increased operation and maintenance costs to preserve the aging air traffic control system.

FAA has attached a dollar value to these anticipated benefits. Specifically, FAA anticipates that the CIP projects will provide $258 billion in benefits--$32 billion in benefits to FAA and $226 billion in benefits to airway and airspace system users. Through fiscal year 1991, FAA expects that $24 billion in benefits will accrue from partially or fully completed projects. For example, FAA believes that Phase I of the Traffic Management System is already providing significant flow control efficiencies and that the modern Host Computer is providing needed capacity.

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[6]Air Traffic Control: Continued Improvements Needed in FAA's Management of the NAS Plan (GAO/RCED-89-7, Nov. 10, 1988).

Section 2

THE STATUS OF 12 MAJOR PROJECTS

This section provides information on changes in costs and schedules for 12 major acquisition projects. It also includes a cost index that shows how cost changes are related to changes in quantity requirements. Funding requirements for these projects have increased as well as delays in first- and last-site implementation. A comparison of FAA's 1983 and 1991 financial plans shows that total costs for these 12 projects through the year 2000 have risen by 52 percent since the projects were included in the NAS Plan. In addition, delays in first- and last-site implementation for these projects have averaged about 5 years. Furthermore, in a single year, costs have grown for 7 of the 12 projects, first-site implementation has been delayed for 3 projects, and last-site implementation has been delayed for 5 projects.

Costs for the 12 major systems that we reviewed in detail represent about 33 percent of the total 1991 F&E costs that FAA has estimated for its modernization effort through fiscal year 2000. These 12 projects are also expected to generate $148 billion (57 percent) of the total $258 billion in benefits that FAA believes will accrue to itself and ATC system users. Figure 2.1 briefly describes each project, compares total F&E cost estimates for 2 years, and summarizes key progress and problem issues for 1991. A discussion of each project's progress and problems can be found in the subsection entitled "Progress and Problems Associated With the 12 Major Systems."

Figure 2.1 also identifies 3 projects that could be affected if FAA modifies its air traffic consolidation plan. As we reported in 1991, a probable change in FAA's ATC consolidation plan will increase costs.[1] The current CIP is based on FAA's plan to consolidate 202 terminal radar approach control facilities and en route centers into 23 facilities. For the last several years, however, FAA has had serious reservations about the operational feasibility of this plan because of the potential impact on the ATC system of a catastrophic failure at any of these consolidated facilities. FAA vulnerability studies indicate that if a consolidated facility failed, adjacent facilities could not adequately manage the airspace. Aircraft delays and the risk of tragic accidents would then increase.

Because of the current consolidation plan's vulnerability, FAA has studied alternative consolidation plans, including a plan

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[1]FAA Budget: Key Issues in Facilities and Equipment and Operations Accounts Need Resolution (GAO/T-RCED-91-58, June 5, 1991).

calling for 53 or 54 facilities instead of the 23 in the CIP. If FAA determines that more than 23 consolidated ATC facilities are needed, additional Advanced Automation Systems (AAS), Voice Switching and Control Systems (VSCS), and Central Weather Processor Systems (CWP) will probably be required. For example, VSCS equipment needs could almost double. According to an FAA estimate, under such a scenario during the next decade, the agency would need an additional $2.5 billion in F&E funds. However, as we testified just last month, we believe that these estimates may be low, given that in 1988 FAA estimated that another consolidation plan, which included 44 sites, would cost an additional $4 billion.[2] In any case, a change in FAA's consolidation plan will have a major impact on F&E funding levels over the next few years.

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[2]Air Traffic Control: Challenges Facing FAA's Modernization Program (GAO/T-RCED-92-34, Mar. 3, 1992).

Figure 2.1 Major System Summary

Project by function	Description and anticipated benefits	2-year comparison of total F&E cost estimates (In millions of current dollars)		
En Route		1991	1992	Difference
Advanced Automation System (AAS) (2001)[a]	- Replaces hardware, software, and work stations at air traffic control facilities. - To be implemented in five phases. - Increases controllers' productivity, reduces operating costs, and increases airway safety and efficiency.	$4,453.7	$4,672.9	$ 219.2
Voice Switching and Control System (VSCS) (1997)	- Replaces and improves voice ground-to-ground and air-to-ground communications at air traffic control facilities. - Increases controllers' efficiency and allows safer and more efficient handling of anticipated air traffic increases.	$1,399.8	$1,399.8	None
Flight Service and Weather				
Automated Weather Observing System (AWOS) (1997)	- Obtains aviation-critical data, such as wind velocity, temperature, dew point, altimeter setting, cloud height, and visibility. - Processes and transmits weather data to pilots via a synthesized computer voice. - Improves air safety at small, nontowered airports and eliminates or reduces observation errors at larger airports.	$ 189.5	$ 216.2	$ 26.7
Central Weather Processor (CWP) (1998)	- Collects, synthesizes, and disseminates weather data, tailoring it to users' needs. - Includes Meteorological Weather Processor and Real-time Weather Processor. - Reduces weather-related accidents and air traffic delays.	$ 136.5	$ 136.5	None
Flight Service Automation System (FSAS) (1995)	- Provides pilots with automated weather data and access to the FAA system identifying any national airspace system changes. Also simplifies flight plan filing. - Increases flight service efficiency and mitigates cost of additional staff and facilities to meet potential increase in demand for flight services.	$ 539.8	561.8	$ 22.0

Key progress and problem issues - calendar year 1991	Impact of air traffic consolidation plan
- Five-percent increase in costs primarily attributable to (1) changes in the Tower Control Computer Complex phase of AAS, (2) changes in Initial Sector Suite System (ISSS) software, and (3) a study of remote terminal capabilities for smaller terminal facilities if FAA changes its consolidation plans. - ISSS may not fit into about half of the 20 en route centers scheduled to receive them. FAA expects to complete its analysis of the extent of the space shortage problem by this spring. - Achieved first-site implementation for initial phase.	- $54 million more needed for terminal AASs if additional air traffic control facilities are required. - Contractor requires facility description by summer 1992 to finalize system size.
- Implementation delayed by extension of prototype phase. - Production contract awarded. Upon completion of operational testing on the current prototype and acceptance of the prototype upgrade, FAA will authorize the limited production of five systems. - Limited production is scheduled to begin September 30, 1992.	- Quantity of VSCS equipment needed could almost double.
- Fourteen-percent cost growth attributable to the Automated Surface Observing System (ASOS) part of the project--including higher contract and site preparation costs and the cost of terminating one prototype contract. - Last-site implementation was delayed 3 years because of budgetary reductions and a delay in awarding the ASOS production contract. - AWOS has experienced reliability and maintenance problems, which FAA is working to correct. For example, FAA no longer assesses performance penalties, and the contractor has extra funds to hire more maintenance staff.	- No impact anticipated.
- The Meteorological Weather Processor was completed in December 1991, 6 months late. It is scheduled for Operations funding in fiscal year 1993. - The Real-time Weather Processor's last-site implementation date has been extended by 2 years. The project is on hold, pending completion of FAA's review of system requirements in April 1992.	- One RWP is needed for each AAS. If additional AASs are required, an equal number of RWPs will be needed.
- Net costs for FSAS have grown by 4 percent: a $47.5-million increase primarily for computer replacement and a $25.5-million decrease primarily for elimination of a graphic weather display and reduction in costs for support space whose requirements had been poorly defined. - Twenty-five automated fight service stations were commissioned as of February 1992. - FSAS has not changed first- or last-site implementation dates.	- No impact anticipated.

Figure 2.1. Major System Summary (continued)

Project by function	Description and anticipated benefits	2-year comparison of total F&E cost estimates (In millions of current dollars)		
Ground-to-Air		1991	1992	Difference
Air Route Surveillance Radar (ARSR-4) (1996)	- Provides for long-range surveillance radar, en route navigation, air defense, and drug interdiction, including the detection of low-flying aircraft. - Decreases costs by substituting unmanned radar for old, hard-to-maintain systems and reducing number of site operators required.	$ 383.7	$ 383.7	None
Airport Surface Detection Equipment-3 (ASDE-3) (1994)	- Enables busy airports to monitor ground activity of aircraft and other vehicles under all weather conditions. - Is capable of scanning entire airport facility and focusing on specific areas. - Increases surface safety and collision avoidance by replacing aging and less reliable ASDE-1 and -2 radar equipment.	$ 130.5	$ 158.2	$ 27.7
Airport Surveillance Radar (ASR-9) (1993)	- Provides highly accurate monitoring of aircraft movement/position within a radius of 60 miles from the airport terminal. - Displays weather and aircraft information simultaneously. - Increases busy airport's safety by providing more accurate data to separate and control aircraft movements into and out of airports.	$ 701.8	$ 761.8	$ 60.0
Microwave Landing System (MLS) (2008)	- Gives electronic guidance to aircraft for precision approaches and landings in any weather conditions. - Promotes safety in bad weather and reduces costs by expanding airspace through increased approach and departure capacity.	$2,623.7	$2,623.7	None
Mode Select (Mode S) (1996)	- Reduces signal interference between aircraft and establishes a clear message channel between the aircraft and ground facilities. - Allows pilots to obtain weather information directly, rather than through controllers. - Improves safety by identifying the location of aircraft more accurately.	$ 424.0	$ 424.0	None

Key progress and problem issues - calendar year 1991	Impact of air traffic consolidation plan
- Two of ARSR-4's scheduled deadlines leading to first-site implementation have slipped. However, the year of first- and last-site implementation has not changed. - These slips occurred because FAA did not prepare the first site on schedule and because a contract dispute over price took place between the contractor and a subcontractor. This dispute delayed delivery of power transistors, a key part of radar, which in turn delayed completion of qualification testing.	- No impact anticipated.
- Cost growth of 21 percent includes about $11 million for spare parts and a maintenance contract, $9 million for site changes and enhancements at airports requiring two ASDE-3s, and $7.7 million for fixing a radar display problem. The radar splits the image of large objects--particularly aircraft with long fuselages--into two or more images, presenting a potentially confusing image. - First-site implementation was delayed by 3 months, from December 1991 to March 1992; the last-site implementation date remains unchanged. - FAA is implementing the ASDE-3 radar with the split-image problem because, even with this problem, ASDE-3 improves controllers' tracking of aircraft. FAA expects to fix this problem by fiscal year 1994.	- No impact anticipated.
- Costs have increased by 9 percent largely to allow FAA to establish one, and complete six, radars at sites not originally designated for ASR-9s. - Last-site implementation has been delayed by 1 year, and only 31 of the 82 delivered systems have been commissioned. A fault in the transmitter component design, which was not detected during operational testing, has caused the outage at some sites. FAA is uncertain why the faults occur sporadically. FAA expects transmitter modifications, which it plans to implement by mid-May 1992, to cost at least $10 million.	- No impact anticipated.
- No cost growth occurred since last year or implementation slips since the 1990 CIP. However, the development contracts will be awarded 7 months late. - In June 1991, FAA awarded a contract for 26 Category I MLSs, which are scheduled for delivery in the summer of 1992. FAA plans to buy 1,250 Category II/III MLSs in two phases: 464 MLSs in Phase I and 786 MLSs in Phase II.	- No impact anticipated.
- A full-production contract was signed about 8 years ago; however, no operational system has been received. First-site implementation was delayed from 1992 to 1993. - Software-development difficulties that have delayed the project for years are not yet fully resolved. In response to these continuing difficulties, FAA is expanding the Mode S operational and evaluation program. FAA has also begun an Interim Beacon Initiative that provides less-capable radar services to sites awaiting Mode S.	- No impact anticipated.

Figure 2.1. Major System Summary (continued)

Project by function	Description and anticipated benefits	2-year comparison of total F&E cost estimates (In millions of current dollars)		
Ground-to-Air (con't)		1991	1992	Difference
Terminal Doppler Weather Radar (TDWR) (1996)	- Detects wind shear and microbursts around airports, as well as gust fronts, wind shifts, and precipitation. - Promotes safety by providing alerts of hazardous weather conditions in terminal areas and of changing wind conditions that influence runway usage.	$ 327.6	$ 340.6	$ 13.0
Interfacility Communications				
Radar Microwave Link (RML) - Replacement and Expansion[b] (1994)	- Replaces and expands aging RML. Consists of the RCL Backbone, a Low Density RCL, and a Routing and Circuit Restoral system. - Reduces costs and promotes safety by providing an effective, reliable voice and data service connecting Air Route Traffic Control Centers, long-range radars, and other air traffic facilities.	$ 284.3	$ 313.3	$ 29.0

[a]Year in parentheses is FAA's 1991 CIP estimate for last-site implementation.

[b]Referred to as "Radio Communications Link" (RCL) in last year's fact sheet (GAO/RCED-91-132FS)

Source: GAO analysis of FAA data.

Key progress and problem issues - calendar year 1991	Impact of air traffic consolidation plan
- Cost growth of 4 percent attributable to $5 million for integrating the project with the Low-Level Wind Shear Alert System (LLWAS), $7 million for spares, and $1 million for a program support facility. Additional funding may be needed to solve software development problems that affect TDWR and LLWAS integration. These needs were not identified in the original contract. - No schedule slips have been identified.	- No impact anticipated.
- Cost growth of 10 percent includes $13 million for replacement of structurally defective towers; $9.5 million for unanticipated work, such as replacing antennas disabled by gunfire; $2.5 million for unanticipated equipment needs; $2 million for additional sites; and $2 million for increases in land costs. - RCL: 811 of the 818 RCL units were installed and tested by February 1992. - This project's last-site implementation slipped by 1 year--from 1993 to 1994. Because the initial contract award for the Routing and Circuit Restoral system is not scheduled until June 1993, program officials believe it may be difficult to meet the 1994 implementation date.	- No impact anticipated.

COST AND REQUIREMENT CHANGES SINCE 1983

We developed unit cost indexes for 11 of the 12 major projects we reviewed.[3] Since the 1983 NAS Plan, FAA changed quantity requirements for 8 of these 11 projects. To compare current estimated costs with initial cost estimates for these projects, we calculated unit costs for both periods. Specifically, we divided both initial and current costs by the number of units--radars, sites, or facilities--scheduled to be produced or served. As table 2.1 shows, the estimated unit costs increased for 10 of the 11 systems that we could compare. Costs for AAS, which more than doubled, represent the largest dollar-value increase--$113 million per facility. Costs for VSCS units, which more than quadrupled, represent the largest proportional increase--from $10.3 million to $56.0 million for the same system.

Furthermore, although quantity requirements for 4 of the 11 projects were reduced, the F&E cost index increased. For example, FAA decided to purchase 47 Terminal Doppler Weather Radars (TDWR) instead of 102. This 55-unit reduction decreased total costs from $550 million to $340.6 million but increased the costs of an individual radar from $5.4 million to $7.3 million. FAA officials say that they are buying fewer TDWRs because their cost-benefit analysis indicated that only 47 radars were required. They have attributed much of the increase in costs to the loss of economies of scale that they had expected to realize by buying a larger number of radars. However, part of the increase is attributable to costs that FAA did not originally include, such as the costs of integrating radars with the Low-Level Wind Shear Alert System, buying additional spares, and providing a program support facility.

[3]Because the scope of the Central Weather Processor was extensively revised in 1987, we could not compare unit cost estimates for this project.

Table 2.1: Unit Cost Changes for 11 Major CIP Projects

In millions of current dollars

Project	1983 F&E costs	1983 planned units	1983 F&E cost index	Current F&E costs[a]	Current planned units	Current F&E cost index	Percent change in unit cost
AAS	$2,069.9	23 facilities	$90.00	$4,672.9	23 facilities	$203.17	126
ARSR-4	425.8	48 radars	8.87	383.7	39 radars	9.84	11
ASDE-3	83.2	21 radars	3.96	158.2	30 radars	5.27	33
ASR-9	930.9	96 radars	9.70	761.8	118 radars	6.46	-33
AWOS	160.7	700 units	.23	216.2	737 units	.29	28
FSAS	305.1	61 stations	5.00	400.0[b]	61 stations	6.56	31
MLS	1,245.6	1,250 systems	1.00	2,623.7	1,280 systems	2.05	106
Mode S	487.2	197 systems	2.47	471.5[c]	137 systems	3.44	39
RML Repl/Exp	264.3[d]	1,000 sites	.26	313.3	875 sites	.36	35
TDWR	550.0[d]	102 radars	5.39	340.6	47 radars	7.25	34
VSCS	258.6	25 units	10.34	1,399.8	25 units	55.99	441

[a]Based on program official's most recent estimate of F&E cost.

[b]Excludes $161.8 million currently identified for computer replacement, space needs, and power conditioning systems. These items were not included in the 1983 plans for the FSAS project.

[c]Includes $47.5 million for the Aeronautical Data Link project. In 1983, the data link was part of the Mode S program.

[d]Cost and schedule data from 1985 and 1987 are used for the RML Replacement and Expansion project and the Terminal Doppler Weather Radar project, respectively, because earlier data are not sufficient to create a cost index

Source: GAO analysis of FAA data.

SCHEDULE SLIPS

As table 2.2 shows, schedules have slipped for 11 of the 12 major acquisitions that we have reviewed since 1983.[4] Table 2.2 focuses on the two milestones that estimate when the first and last systems will be implemented. The average delay from the 1983 NAS Plan to the 1991 CIP for first-site implementation is the same as we reported last year--about 5 years.[5] Slips for individual projects range from 1 to 12 years. However, the average delay in last-site implementation for the same period has increased from the 4 years we reported last year to 5 years.

In addition, a comparison of the 1990 and 1991 CIPs shows that, within this last year, FAA has rescheduled either the first or last-site implementation dates for 7 of the 12 projects. For 1 of the 12, the Voice Switching and Control System (VSCS), FAA has rescheduled both milestones, extending them by a year. The VSCS slips are particularly worrisome because VSCS provides the communication capabilities for the controller work stations in AAS.

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[4]TDWR was not included in the 1983 NAS Plan.

[5]Air Traffic Control: Status of FAA's Modernization Effort (GAO/RCED-91-132FS).

Table 2.2: Implementation Milestones for 12 Major FAA Projects

	Year of first-site implementation			Years delayed	Year of last-site implementation			Years delayed
System	83 NAS	90 CIP	91 CIP	83 NAS - 91 CIP	83 NAS	90 CIP	91 CIP	83 NAS - 91 CIP
Advanced Automation System	1990	1992	1991	1	1994	2001	2001	7
Air Route Surveillance Radar (ARSR-4)	1985	1993	1993	8	1995	1996	1996	1
Airport Surface Detection Equipment (ASDE-3) Radar	1987	1991	1992	5	1990	1994	1994	4
Airport Surveillance Radar (ASR-9)	1985	1989	1989	4	1992	1992	1993	1
Automated Weather Observing System	1986	1989	1989	3	1990	1994	1997	7
Central Weather Processor	1990	1991	1991	1	1991	1996	1998	7
Flight Service Automation System	1984	1991	1991	7	1989	1995	1995	6
Microwave Landing System	1985	1997	1997	12	1999	2008[a]	2008[a]	9
Mode S	1986	1992	1993	7	1993	1996	1996	3
Radar Microwave Link Replacement and Expansion	1985	1986	1986	1	1989	1993	1994	5
Terminal Doppler Weather Radar	[b]	1993	1993	[b]	[b]	1996	1996	[b]
Voice Switching and Control System	1989	1994	1995	6	1992	1996	1997	5
Average delay (in years)				5				5

[a]The last-site implementation date is for all 1,280 Microwave Landing Systems. GAO/RCED-91-132FS reported CIP last-site implementation for Phase I systems only.

[b]The Terminal Doppler Weather Radar project was not included in the 1983 NAS Plan.

Source: Implementation dates for 1983 and 1990 are from FAA's 1983 NAS Plan and 1990 CIP, respectively. Implementation dates for 1991 are from the unpublished 1991 FAA CIP.

PROGRESS AND PROBLEMS ASSOCIATED WITH THE 12 MAJOR SYSTEMS

The following summaries of the 12 major projects we reviewed include (1) information on the project changes and funding histories, (2) reasons for changes in project implementation dates and total cost estimates, and (3) a description of key accomplishments and problems encountered on each project since we issued our 1991 report.

FAA program offices for these 12 projects provided us with (1) total F&E cost estimates during fiscal years 1991 and 1992, (2) cumulative F&E funds appropriated through fiscal years 1991 and 1992, and (3) cumulative F&E funds obligated through fiscal year 1991. Fiscal year 1992 F&E figures are based on estimates current at the time of our review. In some instances, the program managers' cost estimates for 1992 may change as FAA evaluates funding for the project. For example, although net costs for FSAS increased by $22.0 million between 1991 and 1992, FAA deleted $3 million from its estimate of space support costs because these requirements were poorly defined.

ADVANCED AUTOMATION SYSTEM (AAS)

Vendor: International Business Machines (IBM), Rockville, Maryland

AAS Progress and Problems

FAA will implement the Advanced Automation System in five phases: (1) the Peripheral Adapter Module Replacement Item (PAMRI), (2) the Initial Sector Suite System (ISSS), (3) the Terminal Advanced Automation System (TAAS), (4) the Area Control Computer Complex (ACCC), and (5) the Tower Control Computer Complex (TCCC).

FAA's most current estimate of total F&E costs for AAS has increased by $219.2 million--from $4,453.7 million to $4,672.9 million--since last year. The major reason for this increase is that an additional $149.6 million will be needed to improve man-machine interfaces for the TCCC portion of AAS. Other increases include $30.0 million for changes in ISSS software needed to met additional FAA requirements and $13.5 million for a study of alternative plans for smaller terminal facilities in the event that FAA revises its original consolidation plans. The remaining $26.1-million increase is due to various project changes. The schedule and performance progress of each of the five phases is outlined below.

PAMRI

During the past year, the first of 20 PAMRI systems to be delivered to the field reached operational readiness. This enabled FAA to achieve its scheduled first-site implementation date of October 1, 1991. The AAS program office estimates that PAMRI installations will continue essentially on schedule to meet the last-site implementation date of July 1, 1993. However, FAA needs additional radar display equipment to increase system redundancy. This change will be introduced in PAMRI systems beginning with the fifteenth site. Retrofits for the first 14 sites will begin in February 1993.

ISSS

According to the FAA division manager for AAS, ISSS is the most important component of the AAS project because much subsequent software and hardware development depends on this component. The division manager says that ISSS is proceeding on schedule toward a first-site implementation date of August 1995. The next major milestone for ISSS is delivery to the FAA Technical Center in November 1992 for testing. IBM has completed eight of nine scheduled operational software modules for ISSS, and FAA is performing preliminary operational tests of the system hardware and software. Although FAA has not changed any major ISSS milestones in the last year, ISSS software development has fallen about 5 to 6

months behind schedule because, according to the AAS division manager, an additional software development module is needed to alleviate software performance problems discovered during testing in 1991. FAA's January 1992 analysis of the IBM contract indicates that these software problems will, at a minimum, delay the scheduled delivery to the Technical Center by 2 months.

FAA officials said that about half of the 20 en route centers may not have room for all controller work stations during the transition to ISSS. This space shortage problem has arisen because the number of work stations at each facility may exceed planning estimates. Additionally, space needed for en route support functions has increased over the years. FAA's air traffic requirements organization is evaluating facility requirements and analyzing alternatives to alleviate this problem, such as (1) moving certain support functions off of the control room floor and (2) building a mezzanine level above the control room. FAA plans to finish analyzing the extent of the space shortage and decide on solutions by this spring.

TAAS

The critical design review (CDR) was completed in January 1992. Formal milestones for the TAAS portion of AAS have not changed during this past year--first-site implementation remains scheduled for January 1997.

ACCC

The CDR for ACCC has slipped by 9 months to October 1992. The AAS program office attributes this delay to FAA's plan to absorb congressional funding cuts in the office's fiscal year 1992 budget and to schedule slippage in software design and systems engineering tasks for ACCC. First-site implementation for ACCC had been scheduled for February 1998. FAA took this delay as an opportunity to redefine the present ACCC and related Automated En Route Air Traffic Control (AERA) products into four packages representing the same capabilities. First-site implementation dates for these packages are as follows: Host computer replacement, February 1998; initial AERA service, February 1999; AERA 2, February 2000; and final capabilities, February 2001.

TCCC

The CDR conference schedule for TCCC has slipped by 4 months, from February to June 1992, because of problems with the TCCC work stations that inhibited controllers' movement in the tower cab and limited their ability to maintain awareness of the airport environment. To address these problems, FAA and IBM have worked on voice recognition and developed special hardware, such as 25-foot tethers, for remote operation of work station controls. The first-site implementation date for TCCC remains January 1997.

Two-Year AAS Funding History
(Dollars in millions)

	FY 1991	FY 1992
Total estimated F&E cost	$4,453.7	$4,672.9
Cumulative F&E funds appropriated through	1,445.5	1,890.5
Cumulative F&E obligations	1,358.3	---

AIR ROUTE SURVEILLANCE RADAR (ARSR-4)

Vendor: Westinghouse Electric Company, Baltimore, Maryland

ARSR-4 Progress and Problems

According to FAA, neither the cost estimate nor the years of first- and last-site implementation have changed for ARSR-4. However, the project experienced a 9-month slip in its working date for first-site implementation, from January 1993 to October 1993. According to the program manager, the delay resulted from two independent factors. First the date of first-site preparation slipped by 9 months, from November 1991 to August 1992. Second, FAA now believes that Westinghouse will not complete qualification testing by June 1992, as originally anticipated. The main reason for this second delay is that a subcontractor has not met its schedule for delivery of power transistors, a key part of the solid-state radar. According to FAA, the subcontractor claimed that its costs were exceeding the price it was receiving under the fixed-price contract. In response to this problem, Westinghouse will now produce some of the transistors internally to supplement production. FAA now expects qualification testing to be completed in September 1993 and first-site implementation to occur in October.

Two-Year ARSR-4 Funding History
(Dollars in millions)

	FY 1991	FY 1992
Total estimated F&E costs as of	$ 383.7	$ 383.7
Cumulative F&E funds appropriated through	176.6	256.6
Cumulative F&E obligations	162.8	--

AIRPORT SURFACE DETECTION EQUIPMENT (ASDE-3) RADAR

Vendor: Norden Systems, Inc., Long Island, New York

ASDE-3 Progress and Problems

Total estimated project costs for ASDE-3 have risen over the past year by $27.7 million, from $130.5 million to $158.2 million. Project costs increased because of the need to, among other things, solve the split-target problem, change the site configuration, and purchase spare parts and a maintenance contract. According to the program manager, FAA will contract for some ASDE-3 maintenance until the FAA depot can assume complete responsibility for maintaining the new system.

FAA awarded a contract for the development and production of ASDE-3 to Norden Systems in 1985 and planned to implement the first ASDE-3 radar in March 1992. Delays in installing ASDE-3 over the last several years have occurred because (1) FAA and the contractor underestimated the complexity of developing the radar system's software, (2) FAA changed some of its requirements, and (3) testing uncovered performance problems that required time to fix.[6] After recognizing a 20-month slip last year, FAA has not revised this milestone for the 1992 CIP--the date for first-site implementation has remained March 1992. Last-site implementation has remained unchanged since last year.

FAA plans to install the ASDE-3 even though it currently has a "target-splitting" problem. The target-splitting problem causes some types of aircraft on the ground to appear as two or more aircraft on the radar user's display screen. The target-splitting is more apparent when the radar is used to focus in on an aircraft to magnify its image. FAA believes that even with this problem, ASDE-3 will significantly improve controllers' current abilities to track aircraft on the ground at night and during periods of low visibility. FAA has begun to explore solutions to the target-splitting and expects to begin fixing the problem sometime in fiscal year 1994--at a cost to FAA of $7.7 million. FAA also expects a $9-million increase in ASDE-3 project costs in fiscal year 1994 for site-configuration changes and enhancements for airports that require two ASDE-3s. Costs for both of these activities are recognized in the current cost estimate.

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[6]Airport Safety: New Radar That Will Help Prevent Accidents Is 4 Years Behind Schedule (GAO/T-RCED-91-78).

Two-Year ASDE-3 Funding History
(Dollars in millions)

	FY 1991	FY 1992
Total estimated F&E costs as of	$130.5	$158.2
Cumulative F&E funds appropriated through	130.5	138.5
Cumulative F&E obligations	112.9	--

AIRPORT SURVEILLANCE RADAR (ASR-9)

Vendor: Westinghouse Electric Company, Linthicum, Maryland

ASR-9 Progress and Problems

Project costs have increased by an estimated $60 million in the last year. Also, since the 1990 CIP, the last-site implementation date for ASR-9 has been delayed from 1992 to 1993. Furthermore, ASR-9 delivery and commissioning and ASR-7/8 relocation schedules are not being met. ASR-7/8 relocations are part of the ASR-9 project.

According to the FAA program manager, the majority of the cost increase incurred last year was caused by the establishment of one, and the completion of six, radar sites that FAA had not originally designated to receive ASR-9s.

As of December 1991, 82 out of 96 anticipated ASR-9 systems had been delivered. Of the 82 delivered ASR-9 systems, only 31 had been commissioned--approximately half of the 63 anticipated. FAA attributes the delay in commissioning to a fault in the design of an ASR-9 transmitter component. This fault, which causes sporadic outages at some (but not all) sites, was not detected during operational testing of the first ASR-9. To determine why the faults occur, FAA contracted with Lincoln Laboratories to perform a study of the transmitter design. The study resulted in design modifications that FAA plans to implement by mid-May 1992. FAA has estimated that it will cost at least $10 million to modify the transmitter.

The delays in ASR-9 commissioning have slowed the ASR-7/8 relocation project, since the older radars cannot be removed until the newer systems have been commissioned. As of December 1991, 22 ASR-7s and ASR-8s had been relocated--6 fewer than the 28 systems scheduled for relocation by that date.

Finally, the ASR-9's program office noted that the radar's operational availability remains below the 99.9-percent rate specified in the contract. During the last year, the project's operational availability rate rose to 99.8 percent, up from 98.2 percent the year before. FAA anticipates that ASR-9 will meet the specified rate next year.

Two-Year ASR-9 Funding History

(Dollars in millions)

	FY 1991	FY 1992
Total estimated F&E costs as of	$701.8	$761.8
Cumulative F&E funds appropriated through[7]	683.6	735.2
Cumulative F&E obligations	624.5	---

[7]FAA's ASR-9 program office revised the FY 1991 cumulative appropriation estimate that we reported last year.

AUTOMATED WEATHER OBSERVING SYSTEM (AWOS)

Vendors: Qualimetrics, Inc., Sacramento, California (AWOS), and AAI Corporation, Hunt Valley, Maryland (ASOS)

AWOS Progress and Problems

AWOS costs have increased by $26.7 million--from $189.5 million last year to $216.2 million this year. In addition, both the schedules for AWOS and the Automated Surface Observing System (ASOS), which is funded under the AWOS umbrella, have slipped since last year. Under the AWOS project, FAA provides funds to a consolidated project run by the National Oceanic and Atmospheric Administration (NOAA) to procure ASOS for FAA, the National Weather Service (NWS), and the Department of Defense. The $26.7-million increase is due to several changes in the ASOS portion of the project. First, the NOAA contract costs for FAA's 537 ASOS systems are about $12.4 million more than FAA budgeted for its share of the cost for this contract. Second, the actual ASOS site-preparation and installation costs are $4.8 million more than FAA originally estimated. Third, a clause in the ASOS contract that ties the price of ASOS units to an index related to the economy is expected to add $3.5 million to the cost. In addition, about $3.9 million more than was budgeted will be required for support, engineering, and the first year of maintenance. Finally, costs rose by $2.1 million because of contract modifications for emergent requirements and the costs associated with terminating the contract with the competing ASOS prototype builder.

FAA began commissioning AWOS in 1989 and received all 200 systems from the contractor in a two-stage procurement. However, FAA has encountered site preparation, installation, and maintenance problems in meeting its implementation schedule. Last year, FAA planned to have achieved last-site implementation for the 160 systems in the original procurement by December 1991. However, as of February 14, 1992, FAA had commissioned only 142. The remaining 18 are expected to be implemented in the field by December 1992. To date, none of the 40 AWOSs procured in the second stage have been installed. The last-site implementation date for these 40 is expected to be March 1994.

The first-site implementation date for ASOS slipped from September 1991 to September 1992. This schedule slip resulted from (1) equipment discrepancies that delayed system acceptances, (2) the unavailability of government-furnished equipment (GFE) ground-to-air radios, and (3) the unavailability of GFE modems and associated long-line communications network. Our analysis of CIP dates showed that the last-site implementation date for ASOS slipped from September 1994 to May 1997. According to FAA officials, budgetary reductions in each of the past 3 fiscal years

and approximately a year's delay in awarding the ASOS production contract caused this slip.

Two-Year AWOS Funding History

(Dollars in millions)

	FY 1991	FY 1992
Total estimated F&E costs as of	$189.5	$216.2
Cumulative F&E funds appropriated through	117.2	144.2
Cumulative F&E obligations	96.4	--

CENTRAL WEATHER PROCESSOR (CWP)

Vendor: Harris Corporation, Melbourne, Florida

CWP Progress and Problems

The CWP project has two components: the leased, commercially available Meteorologist Weather Processor (MWP) and the Real-time Weather Processor (RWP). Although the CWP project cost estimate has not grown since last year, the MWP portion of the project was deployed 6 months later than FAA expected. Also, according to FAA officials, work on the RWP portion is currently suspended pending a requirements review. In addition, FAA has postponed CWP's last-site implementation by 2 years since last year.

The MWP component, which distributes weather data to meteorologists at major FAA control centers, is now fully deployed and in the third year of its lease. MWPs are located in 21 en route centers; in addition, two are housed in FAA's Air Traffic Control System Command Center (Central Flow) facility. MWP deployment, completed in December 1991, was delayed by 6 months. According to the program manager, this delay was due to training problems and difficulties with the contractor at the first site. He also said that because the contract for the present MWP system expires in 1994, FAA is planning an MWP follow-on system.

Work on the RWP component, developed as a unique FAA weather system, is currently suspended because of budget cuts until after an FAA team has reviewed the system's requirements, according to the program manager. The review is scheduled to be completed by April 1992. The CWP program manager also said that since RWP will interface with the ACCC portion of AAS--a system whose implementation is still years away--FAA will assess any procurement-related options and schedules before proceeding with a full production contract. In addition, after the Jet Propulsion Laboratory, which developed the RWP prototype, finishes software testing for the RWP prototype, RWP work will stop until FAA has completed the requirements review.

Two-Year CWP Funding History

(Dollars in millions)

	FY 1991	FY 1992
Total estimated F&E costs as of	$136.5	$136.5
Cumulative F&E Funds appropriated through	68.7	75.2
Cumulative F&E obligations	67.7	--

FLIGHT SERVICE AUTOMATION SYSTEM (FSAS)

Vendor: E-Systems, Inc., Garland, Texas

FSAS Progress and Problems

Since last year, the net estimated cost of the FSAS project has increased by $22.0 million (an increase of $47.5 million and a decrease of $25.5 million). The cost increase is due primarily to a net increase of $42.0 million in costs for the computer replacement portion of the FSAS project. Although FAA reduced its estimate of the costs to replace computers by $13.7 million in the short term, it anticipates that it will need a total of $55.7 million more for computer replacement through the year 2000. The cost decrease for FSAS is due primarily to the deletion of a $22-million graphic weather display system and the reduction of $3 million in costs for support space, whose requirements had been poorly defined.

Last-site implementation dates for the project have not changed since last year.[8] Under the Model 1 Full Capacity portion of the FSAS project, two aviation weather processors have been installed and commissioned at Atlanta, Georgia, and Salt Lake City, Utah. Of the 21 Flight Service Data Processing Systems (FSDPSs), 7 have been commissioned. Of the 61 Automated Flight Service Stations (AFSSs), 25 have been commissioned.

Since our report last year, the Model 1 Full Capacity first-site implementation date slipped by about a month, from July 24, 1991, to August 15, 1991, primarily because FAA needed to resolve problems with slow system response time.

In addition to the slow processor response time, we identified two other problems in our report last year: a need for power filters and concerns about supportability beyond 1995. Both FAA's program manager and the SEIC technical advisor believe that the problems with slow processor response time and power filters have now been resolved and that FAA has a plan that will address the supportability problem. Specifically:

-- The problem with slow response time was resolved by improving the software and altering the number of AFSSs to be connected to each FSDPS. Originally the number was to vary between 2 and 7. Now each of the FSDPSs will

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[8]This year, we are using the date of flight service station consolidation/relocation to assess last-site implementation. Previously, we used the date associated with Model 1 full capacity. There have been no last-site implementation slips in either measure since last year.

interface with, on average, 3 AFSSs. This plan allows for better data transfer between the AFSSs and FSDPSs.

-- Once FAA decided that power filters were necessary for the AFSSs, the contractor had to find a subcontractor to supply them. The contractor had problems obtaining filters that would pass factory and site tests. Finally, filters provided by United Power passed factory tests on September 13, 1991, and site tests at Los Angeles on October 16, 1991. As of March 9, 1992, eight power filters had been installed.

-- To enhance system support, FAA will buy as many spare parts as possible to maintain the equipment that is currently being installed. This action should carry the system through 1995. In 1995, FAA will replace some AFSS hardware and upgrade the FSDPS software to maintain the system until 1998. In 1998, according to FAA, all the computers in the AFSSs and FSDPSs will be replaced. The requirements for these replacement computers have not yet been developed.

Two-Year FSAS Funding History

(Dollars in millions)

	FY 1991	FY 1992
Total estimated F&E costs as of	$539.8	$561.8
Cumulative F&E funds appropriated through	356.6	375.8
Cumulative F&E obligations	314.9	--

MICROWAVE LANDING SYSTEM (MLS)

Vendors: Wilcox Electric, Inc., Kansas City, Missouri, and Allied-Signal Aerospace Company's Bendix Communication Division, Baltimore, Maryland

MLS Progress and Problems

FAA currently plans to procure 30 Category I and 1,250 Category II/III MLSs at an estimated cost of $2.6 billion. This project's costs have not grown since last year, nor have the implementation dates changed since FAA's 1990 CIP.

FAA's current estimate of $2.6 billion includes $99.3 million for 30 Category I MLSs; $1.5 billion for 1,250 Category II/IIIs; and $1.0 billion for the MLS demonstration program, program support, and regional site preparation.

The history of FAA's $99.3-million cost estimate for the 30 Category I MLSs is as follows. In 1984, FAA awarded a contract to Hazeltine Corporation for 178 Category I MLSs.[9] This contract was terminated in 1989 because a substantial delay occurred and only two systems were delivered. These two systems cost $79.4 million. Then, in April 1990, FAA purchased two Category I MLSs from Wilcox Electric, Inc., at a cost of about $3 million, for use in a congressionally mandated demonstration project. These systems have been installed at Chicago's Midway Airport and New York's John F. Kennedy Airport. In June 1991, FAA awarded a contract for 26 Category I MLSs to Allied-Signal Aerospace Company's Bendix Communication Division at a cost of $16.9 million. Delivery of these systems is scheduled to begin in the summer of 1992. According to FAA, these are the only additional Category I MLSs that FAA plans to purchase. These systems will be used for demonstration purposes, and once the Category II/III systems are available, the Category I MLSs will be decommissioned.

In addition, FAA plans to buy a total of 1,250 Category II/III MLSs at a cost of $1.5 billion. FAA expects to procure 464 of these systems through the year 2000 under a phase I production contract. Procurement of an additional 786 MLSs is planned after 1999 under a phase II production contract. Since 1981, FAA has reevaluated both the number and cost estimate associated with the

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[9]Precision landing systems are categorized by the distance and elevation that an aircraft can safely descend without the pilot's seeing the runway. If the pilot cannot see the runway at the required minimum distance and elevation, the landing must be aborted. Category I systems require the pilot to make this decision sooner than Category II and III systems.

MLSs several times. In 1981, FAA estimated that 1,250 Category I/II/III systems would cost $2.1 billion. In 1985, the cost of the MLS project was rescoped to $1.5 billion. Then, in 1987, FAA reduced its estimate of the number of systems to be purchased to 960 and again reduced its estimate of the costs to $1.1 billion. In 1990 the number and type of MLSs changed to 464 Category II/IIIs and no Category Is. However, the cost estimate remained at $1.1 billion. In 1990, FAA also created an MLS Capital Investment Plan, supplementing the 464 planned systems with 786 systems and thereby restoring the total planned number of MLS's to 1,250. This revision brought the total cost estimate for the Category II/III MLSs up to $1.5 billion.

According to FAA, full-scale development and limited prototype production of Category II/III MLSs are about to begin. After receiving approval from the Office of the Secretary of Transportation, FAA issued a request for proposals in November 1990. FAA plans to award two MLS development contracts in April 1992--7 months later than planned last year. Two contracts will be awarded to help ensure an adequate supply of MLSs and to reduce technical, schedule, and cost risks. FAA intends to award the full production contracts for the MLSs in 1995, and the first system is scheduled to be delivered in 1996. FAA plans to begin the transition from the Instrument Landing System (ILS) to MLS by January 1, 1998. After MLSs have been installed at all ILS sites, FAA will announce a fixed termination date and transition plan for decommissioning ILSs located in the United States. According to FAA, putting the MLSs in the field will require approximately 10 years. The funding history below identifies estimated costs for the entire MLS project--not just through the year 2000 as we reported last year.

Two-Year MLS Funding History

(Dollars in millions)

	FY 1991	FY 1992
Total estimated F&E costs as of	$2,623.7	$2,623.7
Cumulative F&E Funds appropriated through[9]	200.2	255.2
Cumulative F&E obligations	169.2	--

[9]FAA provided a revised estimate for this period.

MODE SELECT (MODE S)

Vendors: Joint venture between UNISYS, Paoli, Pennsylvania, and Westinghouse Electric Corp., Linthicum, Maryland

Mode S Progress and Problems

According to FAA, the estimate of the total costs for the Mode S surveillance radar project remained the same during the past year. However, the first-site implementation date slipped--primarily because of continuing software development problems.

According to the program office, Mode S is in full production. However, despite having signed a production contract approximately 8 years ago, FAA has not received an operational system. Additionally, software development difficulties that have delayed the Mode S project for years have not been fully resolved. For example, certain sections of the software code, written separately but intended to operate in concert, continue to fail.

In response to these difficulties, FAA has (1) started the Interim Beacon Initiative (IBI) and (2) outlined an accompanying operational testing and evaluation (OT&E) program. The IBI will provide interim, less capable radar services to operational sites waiting for fully capable Mode S software. Mode S ground equipment, configured to perform basic aircraft monitoring functions, will be installed at designated Mode S sites. At the same time, the OT&E program will test Mode S software to ensure that all integration problems have been resolved. The OT&E program calls for completion of terminal airspace testing in December 1992 and en route testing in mid-1993.

Two-Year Mode S Funding History
(Dollars in millions)

	FY 1991[10]	FY 1992
Total Estimated F&E costs as of	$424.0	$424.0
Cumulative F&E Funds appropriated through	351.2	396.2
Cumulative F&E obligations	335.6	--

[10]FAA revised the estimate that it provided to us for last year's fact sheet. Total estimated costs for this period where changed from $424.8 million to $424.0 million. The amount of cumulative F&E funds appropriated was changed from $349.8 to $351.2.

RADAR MICROWAVE LINK (RML) REPLACEMENT AND EXPANSION

Vendors: American Telephone and Telegraph (AT&T) Technologies, Greensboro, North Carolina, and
Rockwell International, Richardson, Texas

RML Replacement and Expansion[11] Progress and Problems

This project comprises three components: the Radio Communications Link (RCL) Backbone, the Low Density Radio Communications Link (LDRCL) Phase I, and the Routing and Circuit Restoral (RCR) Phase I. Since our last report, the total F&E cost estimate for this project has increased by $29 million--from $284.3 million to $313.3 million. This increase was for the RCL portion of the project alone. Cost estimates for LDRCL and RCR components have not changed. However, the last-site implementation date for this project has slipped. The status of the three components is described below.

According to the project manager, as of February 1992, FAA had completed installation and testing at 811 of 818 RCL sites. Because of site acquisition problems, FAA is uncertain when the last RCL site, and hence the last system, can be completed. According to the project manager, the last system will not be operational until July 1992 at the earliest--a schedule slip of 7 months. However, according to FAA, it does not view this slip as a major problem because RCL now handles virtually all of the communications traffic formerly handled by the Radar Microwave Link system.

The estimated $29-million F&E cost increase for the RCL project breaks down as follows: (1) $13 million dollars for replacement of structurally defective towers, (2) $9.5 million to AT&T for unanticipated work, (3) $2.5 million for new equipment, (4) $2 million for the acquisition of additional RCL sites, and (5) $2 million for the increased costs of purchasing required land.

The schedule slips for LDRCL and RCR occurred as follows. The contract for LDRCL was awarded in April 1991. A subsequent protest of the award delayed first-site implementation by 6 months, from January 1992 to July 1992. According to the project manager, the bid protest has been resolved. The contract award for the RCR project, which was originally scheduled for March 1991, is now planned for June 1993, according to the project manager. He said that the 27-month slippage had resulted from delays in the completion of system requirements.

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[11]Referred to as the "Radio Communications Link" in Air Traffic Control: Status of FAA's Modernization Effort (GAO/RCED-91-132FS, Apr. 15, 1991).

Two-Year RML Replacement/Expansion Funding History

(Dollars in millions)

	FY 1991	FY 1992
Total estimated F&E cost as of	$284.3	$313.3
Cumulative F&E Funds appropriated through[12]	267.3	273.3
Cumulative F&E obligations[13]	228.5	---

[12]Following a reprogramming of funds, the appropriations figure through fiscal year 1991 was changed from $257.8 million to $267.3 million.

[13]Last year, we reported cumulative obligations through fiscal year 1990 of $232.4 million. The RML Replacement/Expansion funding office provided a revised estimate of $218.2 million.

TERMINAL DOPPLER WEATHER RADAR (TDWR)

Vendor: Raytheon Company, Sudbury, Massachusetts

TDWR Progress and Problems

The TDWR project has experienced both cost changes and schedule delays during the last year. By disallowing some TDWR cost increases, FAA reduced the $348.8-million fiscal year 1991 estimate that we reported last year to $327.6 million. However, the project also incurred increases totaling $13 million, including $5 million for integrating TDWR with the Low-Level Wind Shear Alert System (LLWAS), $7 million for TDWR work center spares, and $1 million for a project support facility.

The original TDWR contract did not provide for LLWAS integration efforts, but integration of the two systems is an operational requirement. The program manager said that $5 million may not be sufficient to solve software development issues affecting LLWAS integration. FAA is currently negotiating a contract modification with Raytheon for integration work.

The TDWR production contract was awarded on November 2, 1988. The first TDWR system, a training unit identical to a production system, was delivered to FAA in December 1991. Operational testing for TDWR is planned to start during the summer of 1992 and is expected to be completed by November 1992.

According to the program manager, TDWR's first-site implementation date has slipped by 1 month from March 1993 to April 1993, and the last-site implementation has slipped by 3 months from October 1994 to January 1995. These schedule slips occurred because the contractor had to modify government-furnished software elements. However, the last-site implementation date reported in the draft 1991 CIP is 1996. According to the TDWR program manager, this discrepancy exists because (1) the CIP schedule has not been adjusted to reflect a reduction in the number of systems to be implemented and (2) a later CIP last-site implementation date creates an allowance for unexpected problems.

In April 1991, FAA program officials estimated that TDWR would cost $348.8 million upon completion--the figure that we reported as the estimated cost in our April 1991 status report. However, through its internal review process, FAA disallowed $8.2 million in costs and reduced its approved cost estimate to $340.6 million.

Two-Year TDWR Funding History
(Dollars in millions)

	FY 1991	FY 1992
Total estimated F&E costs as of	$327.6	$340.6
Cumulative F&E funds appropriated through	296.6	317.6
Cumulative F&E obligations	249.0	---

VOICE SWITCHING AND CONTROL SYSTEM (VSCS)

Vendors: Harris Corporation, Melbourne, Florida

VSCS Progress and Problems

The VSCS production contract was awarded December 31, 1991. This project has experienced no cost growth since last year. Although first- and last-site implementation dates in the 1991 CIP have slipped about a year from comparable dates in the 1990 CIP, the VSCS program office believes it is on schedule for earlier implementation dates.

In October 1986, FAA awarded VSCS prototype development contracts to Harris Corporation and American Telephone and Telegraph (AT&T) Technologies, Inc., to design, develop, and install separate prototype systems. Both contractors had difficulty producing a system that met FAA requirements. In November 1990, the VSCS project was restructured to minimize risks during the project's production phase. The restructured project required both development contractors to develop a prototype upgrade as well as the prototype.

After 5 years of development, FAA awarded a production contract to Harris Corporation on December 31, 1991. Initially, Harris Corporation will focus its efforts on completing the development of the prototype and the prototype upgrade. After operational testing on the current prototype has been completed and the prototype upgrade has been accepted, FAA will authorize the limited production of five systems. Limited production is scheduled to be authorized by September 30, 1992. The VSCS program manager stated that first- and last-site implementation dates have remained June 1994 and July 1996, respectively, in accordance with the new contract. The 1991 CIP first- and last-site implementation dates are March 1995 and July 1997, respectively. According to the VSCS program manager, FAA is highly confident that work can be completed by the later CIP dates and moderately confident that it can be completed by the earlier contract dates.

Two-Year VSCS Funding History

(Dollars in millions)

	FY 1991[14]	FY 1992
Total estimated F&E costs as of	$1,399.8	$1,399.8
Cumulative F&E funds appropriated through	310.7	468.2
Cumulative F&E obligations	304.9	---

[14]The FAA provided a revised estimate for this period.

AIR TRAFFIC CONTROL MODERNIZATION - INDIVIDUAL PROJECT COSTS

FAA's 1990 and 1991 CIPs identify approximately 200 Air Traffic Control (ATC) modernization projects. However, these CIPs do not include the costs associated with these projects even though the data for doing so are available. To match FAA's modernization projects with their related cost estimates, we developed this appendix. The appendix matches FAA's F&E financial plan cost estimates for 1982 through 2000 with projects in the 1990 and 1991 CIPs. It also matches the F&E cost estimates for 1982 through 1992 with projects in the 1983 NAS Plan.[1] Under certain circumstances, FAA does not identify a discrete project cost. According to FAA, this generally occurs when, for example, a project (1) did not use F&E funds, (2) was combined with another project, or (3) was funded before 1982. The projects in the appendix are listed alphabetically under the part of the air traffic control system that they are intended to improve. Cost estimates are stated in millions of current dollars, and changes are rounded to whole percentages.

We recognize that the total number of modernization projects and the total costs of ATC modernization through the year 2000 will probably increase beyond this year's estimate. FAA's annual CIP reflects the view that modernization is an ongoing process that will not result in a final end-state.

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[1]In 1983, FAA identified costs only through 1992 because the ATC modernization effort was initially envisioned as being completed by that time.

Table I.1: Cost Changes For FAA's Air Traffic Control Modernization Projects

In millions of current dollars

PROJECT NAME	F & E Years 1982-1992 1983
En Route Projects	
Advanced Automation System	$2,069.9
Air Traffic Control (ATC) Application of Automatic Dependent Surveillance	c
Air Route Traffic Control Center (ARTCC) Data System Specialist[a]	c
Area Control Facilities	281.8
Automated En Route Air Traffic Control	4.6
Conflict Resolution Advisory Function	c
Conflict Alert IFR/VFR Mode C Intruder[a]	c
Direct Access Radar Channel System	45.0
Dynamic Ocean Tracking System	c
En Route Automated Terminal System (EARTS) Enhancements[a]	2.8
EARTS Enhancements Continuation	c
En Route Automation Hardware[a]	2.3
En Route Software Development Support	c
En Route Metering II[b]	c
Flight Data Entry and Printout Devices[a]	16.1
Host Computer[a]	316.4
Local Flow Management Enhancements	c
Non Radar Approach Controls[a]	5.9
National Airspace Management Facility	c
Oceanic Display and Planning System	15.0
Oceanic Support	c
Offshore Flight Data Processing System[a]	c

[a]FAA reports these projects as completed.
[b]Combined with the Traffic Management System project on page 54.
[c]Not applicable or data are not available.
Source: FAA Facilities and Equipment Plan for 1983, 1990, and 1991.

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
$4,453.7	$4,471.6	116	0
32.0	32.0	[c]	0
32.0	32.0	[c]	0
111.5	111.5	-60	0
0.0	[c]	[c]	[c]
0.0	[c]	[c]	[c]
[c]	[c]	[c]	[c]
45.0	45.0	0	0
0.9	1.5	[c]	67
2.8	2.8	0	0
[c]	[c]	[c]	[c]
2.3	2.3	0	0
124.6	121.8	[c]	-2
[c]	[c]	[c]	[c]
18.8	18.8	17	0
290.7	290.7	-8	0
28.9	28.9	[c]	0
1.6	1.6	-73	0
631.8	562.0	[c]	11
36.8	36.8	145	0
[c]	8.0	[c]	[c]
1.0	1.0	[c]	0

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
Traffic Management System	10.5
Relocate Air Traffic Control System Command Center	c
Voice Switching and Control System	258.6
Subtotal - En Route Projects	**$3,028.9**
Terminal Projects	
Additional Automated Radar Terminal System (ARTS) IIIA at FAATC[a]	4.7
Airport Movement Area Safety System	c
Airport Surface Traffic Automation	c
Airport Traffic Control Tower (ATCT) Establishment	c
Airport Traffic Control Tower/Terminal Radar Approach Control Establishment, Replacement, and Modernization	372.8
ATCT Closures[a]	1.5
ATCT/Terminal Radar Approach Control (TRACON) Modernization	c
ATCT/TRACON Replacement	c
ATCT System Intra-Connectivity	c
ARTS II Interfacility Interface	c
ARTS IIA Displays[a]	3.6
ARTS IIA Enhancement	12.9
ARTS IIA Interface With Mode S/ASR-9[d]	c
ARTS IIIA Assembler[a]	c
ARTS IIIA Memory[a]	8.6

[d]Combined with the Terminal Radar Program on page 66.

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
142.5	142.5	1,257	0
21.7	27.4	c	26
892.4	1,399.8	441	57
$6,871.0	$7,338.0	142	8
4.7	4.7	0	0
23.0	34.0	c	48
130.2	125.2	c	-4
30.7	12.7	c	-59
410.0	405.8	9	-1
1.5	1.5	0	0
101.0	108.5	c	7
478.7	467.5	c	-2
36.2	36.2	c	0
c	c	c	c
3.6	3.6	0	0
12.9	12.9	0	0
0.0	c	c	c
c	c	c	c
8.6	8.6	0	0

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
Automated Radar Terminal System (ARTS) IIIA Peripheral Adaptor Modernization	c
Automated Radar Terminal System (ARTS) IIIE Upgrades for Select Air Traffic Facilities	c
Automated Terminal Information System (ATIS) Recorders[a]	15.3
Base Buildings for Airport Traffic Control Towers	c
Bright Radar Tower Equipment	25.9
Chicago Area Improvements[e]	c
Combine Radar Approach Into ARTCC[e]	c
Dallas/Fort Worth Metroplex	c
DOD/FAA Air Traffic Control Facility Transfer/Modernization	c
Enhanced Target Generator Displays[a]	c
Enhanced Terminal Conflict Alert[a]	0.4
Establish Additional Radar Positions	c
Establish New Chicago TRACON Facility	c
Establish/Expand Digital Bright Indicator Tower Equipment	c
Expand ARTS IIA Capacity and Provide Mode C Intruder Capability	c
Expand ARTS IIIA Capacity and Provide Mode C Intruder Capability	c
Multichannel Voice Recorders	35.2
National Implementation for the "Imaging" Aid for Dependent Converging Runway Approaches	c
New Airport and Other Facility Planning	c
New Airport Facilities, Denver, Colorado	c

[e]FAA reports project as deleted.

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
5.9	5.9	c	0
c	61.6	c	c
11.2	11.2	-27	0
63.0	32.9	c	-48
64.5	64.5	149	0
c	c	c	c
5.4	5.4	c	0
137.4	147.4	c	7
207.8	207.8	c	0
c	c	c	c
0.4	0.4	0	0
22.0	12.0	c	-45
91.7	98.6	c	8
44.7	44.7	c	0
45.0	45.0	c	0
96.5	109.8	c	14
50.1	54.1	54	8
4.6	4.6	c	0
15.0	12.0	c	-20
180.2	180.2	c	0

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
New Austin Airport[e]	c
Replacement of Controller Chairs	c
Sustain San Juan Facilities	c
Sustain the New York TRACON[a]	c
Southern California TRACON	c
Terminal ATC Automation	c
Terminal Intrusion Function[f]	c
Terminal Software Development	c
Terminal Voice Switch Replacement[g]	22.4
TPX 42 Replacement[a]	40.0
Subtotal - Terminal Projects	**$543.3**
Flight Service and Weather Projects	
Aeronautical Data Link (ADL)	c
ADL Communications and Applications	c
Automated Flight Service Station (AFSS) Support Space	c
Automated Weather Observing System (AWOS)	160.7
Aviation Weather Products Generator	c
Central Weather Processor	76.1
Central Weather Processor Interfaces	c
Consolidated NOTAM System[a]	c
Digital Altimeter Setting Indicator Replacement	c
Direct User Access Terminal (DUAT) Service Geographical Expansion[e]	c

[f]Combined with the Terminal Software Development project on this page.
[g]Formerly the Tower Communications System Project.

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
35.9	[illegible]	[illegible]	[illegible]
5.5	5.5	[illegible]	0
5.0	15.0	[illegible]	200
97.4	97.6	[illegible]	0
121.7	145.9	[illegible]	20
137.0	135.0	[illegible]	-1
5.0	[illegible]	[illegible]	[illegible]
138.8	126.3	[illegible]	-9
139.1	88.1	293	-37
40.0	40.0	0	0
$3,011.9	$2,972.7	447	-1
67.5	50.3	[illegible]	-25
179.5	192.5	[illegible]	7
24.8	21.8	[illegible]	-12
189.5	189.5	18	0
95.5	94.5	[illegible]	-1
136.5	136.5	79	0
20.0	20.0	[illegible]	0
[illegible]	[illegible]	[illegible]	[illegible]
5.0	5.0	[illegible]	0
5.0	[illegible]	[illegible]	[illegible]

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
En Route Flight Advisory Service (EFAS)[a]	5.3
Flight Service Automation System (FSAS)	111.6
FSAS Computer Replacement	c
Geostationary Operational Environmental Satellite (GOES) Recorders[a]	1.9
Hazardous In-Flight Weather Advisory Service (HIWAS)[a]	4.0
Hazardous In-Flight Weather Advisory Service Expansion	c
High Altitude EFAS Expansion[e]	c
Integrated Terminal Weather System	c
Integrated Communications and Switching System	55.1
Integrated Communications Switching System Logistics Support	c
Interim Voice Response System[a]	c
Low-Level Wind Shear Alert System (LLWAS)	7.8
LLWAS Enhancements[h]	c
Operational Database Management System	c
Provide FSAS Power Conditioning System	c
Radar Remote Weather Display System[a]	c
Replace Regional Interim Weather Graphics with National Graphic Weather Display System	c
Upgrade Commercial AWOS System[e]	c
Upgrade LLWAS to Expand Network Configuration	c
Weather Enhancements	c
Weather Message Switching Center Replacement	15.5
Subtotal - Flight Service and Weather Projects	**$438.0**

[a]Combined with Upgrade LLWAS to Expand Network Configuration project on this page.

APPENDIX I

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
6.3	6.3	19	0
317.0	321.7	188	1
110.1	94.6	c	-14
1.9	1.9	0	0
7.3	7.3	83	0
2.0	2.0	c	0
0.0	c	c	c
91.7	89.7	c	-2
98.7	98.7	79	0
10.6	10.6	c	0
c	c	c	c
47.4	47.4	508	0
19.5	c	c	c
c	c	c	c
19.5	19.0	c	-3
c	c	c	c
24.0	c	c	c
13.0	c	c	c
32.9	65.1	c	98
50.0	48.0	c	-4
28.9	28.9	86	0
$1,604.1	$1,551.3	254	-3

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
Ground-to-Air Projects	
Additional ASDE Establishment	c
Adv. Format for Radar/Beacon Target Reports[i]	c
Air Traffic Control Beacon Interrogator (ATCBI) Establishment[j]	c
ATCBI Replacement	c
Air Traffic Control Radar Beacon System Relocation	c
Air/Ground Communications Radio Frequency Interference Elimination	c
Air Ground Radio Replacement	c
Air/Ground Communications Equipment Modernization[a]	72.8
Airport Surface Detection Equipment (ASDE-3) Radar	83.2
AN/GRN-27 Instrument Landing System (ILS) Replacement	c
Approach Lighting System Improvement Program	153.3
Approach Lighting System Improvement Program Continuation	c
AN/FPS-117 Beacon Improvement	c
Airport Surveillance Radar (ASR-9) Modification for Low-Altitude Wind Shear Detection	c
Communications Facilities Consolidation/ Network	174.7
Communications Facilities Expansion	c
Direction Finder	77.9
Emergency Transceiver Replacement	c

[i]Combined with Surveillance System Enhancements project on page 66.
[j]Combined with the Air Traffic Control Beacon Interrogator (ATCBI) Replacement project on this page.

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
48.6	48.6	c	0
c	c	c	c
c	c	c	c
648.3	648.3	c	0
7.2	7.1	c	-1
20.1	13.1	c	-35
78.0	78.0	c	0
60.6	60.6	-17	0
130.5	138.5	66	6
74.4	93.4	c	26
126.1	127.9	-17	1
122.4	122.4	c	0
4.3	9.5	c	121
91.0	89.3	c	-2
23.0	21.0	-88	-9
46.0	46.0	c	0
102.3	118.0	51	15
63.6	63.6	c	0

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
Establish Visual Navaids for New Qualifiers	c
Establish Locator Outer Markers	c
Global Positioning System Monitors	c
Interim Backup Emergency Communications Improvement	c
Improve Capacity of Closely Spaced Parallel Runways	c
Instrument Landing System (ILS)[a]	32.2
ILS and Visual Navaids Engineering and Sparing	c
ILS (Supplemental)	c
Landing Monitor for Closely Spaced Parallel Runways	c
Long Range Radar (Air Route Surveillance Radar) Program	583.9
Long Range Radar Improvements	c
Long Range Radar Radome Replacement	c
Long Range Radar Replacement/Network[e]	c
LORAN Offshore Flight Following	c
LORAN-C Systems	c
LORAN-C Monitors	c
Low-Power TACAN Antennas	c
Microwave Landing System--Phase I	1,245.6
Microwave Landing System--Phase II	c
Mode S	487.2
Non-Directional Beacon[a]	44.2
Oceanic Satellite Communications	c
Radar Pedestal Vibration Analysis	c

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
80.0	80.0	[c]	0
8.4	8.4	[c]	0
33.7	18.7	[c]	-45
50.0	22.5	[c]	-55
70.0	30.0	[c]	-57
69.6	69.6	116	0
71.3	71.3	[c]	0
163.5	159.9	[c]	-2
58.7	108.7	[c]	85
515.7	515.7	-12	0
3.6	93.6	[c]	2,500
52.4	52.4	[c]	0
[c]	[c]	[c]	[c]
1.2	1.2	[c]	0
52.0	52.0	[c]	0
8.7	10.1	[c]	16
62.2	70.2	[c]	13
1,168.4	1,112.8	-11	-5
404.7	266.2	[c]	-34
424.8	424.0	-13	0
24.2	24.2	-45	0
40.5	40.5	[c]	0
5.5	5.5	[c]	0

(continued)

PROJECT NAME	F & E Years 1982-1992 1983
Radio Control Equipment (RCE) Enhancements[e]	c
Replace Mark 1A, 1B, and 1C ILS	c
Replace Second Generation VOR/TACAN/DME[e]	c
Replace Type FA9964 Direction Finder	c
Replace VASI with PAPI	c
Runway Visual Range (RVR)	38.3
Runway Visual Range Establishment	c
Runway Visual Range Replacement	c
Surveillance System Enhancements	c
Sustain VOR/VORTAC	c
Sustain Distance Measuring Equipment (DME)	c
Sustain Nondirectional Beacon	c
Sustain Relocation of Air Route Surveillance Radar (ARSR)	c
Sustain/Relocate Airport Surveillance Radar	c
Takeover of AIP/ADAP Funded Nonfederal ILS and Associated Equipment	c
Terminal Radar (Airport Surveillance Radar) Program	930.9
Terminal Doppler Weather (TDWR) System	c
Terminal Radar Digitizing, Replacement, and Establishment	c
Weather Radar Program	250.5
Wilcox CAT II/III ILS Replacement	c
Visual Navaids	194.7
VORTAC	155.3
Subtotal - Ground-to-Air Projects	**$4,524.7**

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
11.2	c	c	c
121.6	121.6	c	0
0.0	c	c	c
80.0	80.0	c	0
0.0	c	c	c
55.0	56.3	47	2
38.8	38.8	c	0
32.0	32.0	c	0
175.0	155.0	c	-11
30.0	43.9	c	46
60.0	60.0	c	0
65.3	65.3	c	0
89.8	79.8	c	-11
99.4	84.2	c	-15
c	12.5	c	c
701.8	761.8	-18	9
327.6	340.6	c	4
500.0	498.0	c	0
279.2	278.6	11	0
69.0	69.0	c	0
138.1	138.1	-29	0
185.3	171.4	10	-8
$8,074.6	$8,009.7	77	-1

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
Interfacility Communications Projects	
Aeronautical Telecommunications Network	c
Airport Telecommunications[a]	c
Conversion of National Airspace Data Interchange Network (NADIN) IA Users to NADIN II[i]	c
Convert Radio Communications Link (RCL) Network to Digital[e]	c
Critical Telecommunications Support	c
Data Multiplexing Network	23.6
Data Multiplexing Network Continuation	c
Establish Alaskan NAS Interfacility Communication System Satellite Network	c
Expansion/Reconfiguration of Low Density Radio Communication Link	c
Expansion/Reconfiguration of Routing and Circuit Restoral	c
Interfacility Data Transfer System for Edwards AFB RAPCON	c
National Airspace Data Interchange Network (NADIN) IA[a]	11.3
National Airspace Data Interchange Network (NADIN) II	44.9
NADIN II Continuation	c
Network Management and Control Equipment[j]	c
Radar Microwave Link (RML) Trunking[a]	8.2
Radar Microwave Link (RML) Replacement and Expansion	264.3
Radio Control Equipment (RCE)	87.4

[i]Combined with the NADIN II Continuation project on this page.
[j]Combined with the Expansion/Reconfiguration of Routing and Circuit Restoral project on this page.

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
15.0	15.0	a	0
4.2	4.2	a	0
1.8	a	a	a
0.0	a	a	a
195.2	197.2	a	1
44.0	37.6	59	-15
32.6	36.5	a	12
81.7	84.7	a	4
25.0	25.0	a	0
25.0	48.0	a	92
1.8	1.8	a	0
17.0	17.0	50	0
42.5	42.5	-5	0
9.7	31.7	a	227
23.0	a	a	a
8.2	8.2	0	0
283.3	288.8	9	2
302.8	296.8	240	-2

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
Satellite Communications Circuits System	c
Teletypewriter Replacement[a]	15.1
Television Microwave Link[k]	10.1
Subtotal - Interfacility Communications Projects	$464.9
Maintenance and Operations Projects	
Acquisition of Flight Service Facilities	193.5
Aeronautical Center Centralized Integrated Logistics Support Plan[a]	c
Aeronautical Center Lease	c
Aeronautical Center Training and Support Facilities	c
Aircraft and Related Equipment	c
Aircraft and Related Equipment Program	c
Aircraft Fleet Conversion[a]	343.5
Aircraft Fleet Modernization	c
Aircraft Flight Simulators	c
Airmen and Aircraft Registry Modernization	c
Airport Cable Loop Systems Sustained Support	c
ARTCC/ACF Support Space	c
ARTCC Plant Modernization	67.1
ARTCC Resectorization	c
ATCT Safety Upgrades	c
Automated Document Development and Maintenance[l]	c

[k]Combined with the Bright Radar Tower Equipment project on page 56.
[l]Combined with the NASMAP project on page 74.

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
52.6	50.0	[c]	-5
5.1	5.1	-66	0
6.3	6.3	-38	0
$1,176.8	$1,196.4	157	2
80.1	80.1	-59	0
[c]	[c]	[c]	[c]
136.3	139.0	[c]	2
144.5	144.5	[c]	0
94.4	73.2	[c]	-22
110.0	122.3	[c]	11
68.6	68.6	-80	0
487.0	441.2	[c]	-9
12.8	37.7	[c]	195
24.2	35.0	[c]	45
44.1	39.1	[c]	-11
142.7	142.7	[c]	0
327.0	332.0	395	2
[c]	[c]	[c]	[c]
46.2	47.4	[c]	3
[c]	[c]	[c]	[c]

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
Aviation Safety Analysis System	c
Central Repair Facility[e]	c
CIP Systems Engineering and Program Management Support	c
Computer Aided Engineering Graphics Enhancement	c
Computer-Based Instructions[a]	5.4
Computer-Based Instruction Expansion	c
Computer Resources Nucleus (CORN)	c
Continued General Support	c
Development of an Enhanced Radar Analysis Tool	c
Environmental Cleanup	c
FAA National Simulation Laboratory	c
FAA Technical Center Building and Plant Support	c
Frequency Interference Support/ Resolution	c
Fuel Storage Tanks	c
General Support	1,298.7
General Support Laboratory	c
General Support Laboratory Sustained Support	c
Human Resources Management	c
Independent Operational Test and Evaluation Oversight	c
Instrument Approach Procedures Automation	c
Integrated Security Management System	c
Interim Support Program (ISP)	c
Large Airport Cable Loop Systems	116.6

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
208.2	214.2	[c]	3
[c]	[c]	[c]	[c]
728.1	748.2	[c]	3
2.2	2.2	[c]	0
11.4	11.4	111	0
79.5	79.5	[c]	0
158.0	158.0	[c]	0
424.8	554.6	[c]	31
4.8	4.8	[c]	0
114.7	114.7	[c]	0
23.0	6.0	[c]	-74
117.5	118.9	[c]	1
20.5	20.5	[c]	0
161.7	161.7	[c]	0
874.0	855.3	-34	-2
29.5	25.6	[c]	-13
65.7	54.2	[c]	-18
11.5	13.0	[c]	13
59.9	59.9	[c]	0
11.7	12.2	[c]	4
[c]	25.0	[c]	[c]
445.4	434.6	[c]	-2
25.5	20.4	-83	-20

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
Logistics Support System and Facilities	c
Maintenance Control Center (MCC)	c
MCC Enhancement	c
Modernize and Improve FAA Buildings and Equipment	138.9
Modernize and Improve FAA Buildings and Equipment Sustained Support	c
NAS Implementation Support	c
NAS In-Plant Contract Support Services	c
NAS Management Automation Program (NASMAP)	c
NAS Recovery Communications (RCOM)	c
NAS Regional/Center Logistics Support Services	c
NAS Spectrum Engineering	4.6
NAS Spectrum Engineering Sustained Support	c
National Airspace System Training	c
National Airspace Integrated Logistics Support (NAILS)	c
National Aviation Safety Data Center	c
National Radio Communications System[a]	70.2
On-Site Simulation-Based Training Systems	c
Power Systems	1.3[a]
Power System for ARTS III[a]	23.5
Power Systems Sustained Support	c
Provide FAA Housing	c
Refurbish AN/FPS-20 Radars	c
Remote Maintenance Monitoring System (RMMS)	287.9

[a]Represents funding for one year, not a 1982-1992 cost estimate.

APPENDIX I

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
23.1	3.5	[c]	-85
47.9	47.9	[c]	0
70.0	70.0	[c]	0
96.5	86.2	-38	-11
269.6	277.0	[c]	3
105.0	122.2	[c]	16
63.4	58.7	[c]	-7
87.8	87.8	[c]	0
105.8	109.5	[c]	3
121.0	127.8	[c]	6
11.3	9.4	104	-17
15.2	15.2	[c]	0
57.8	69.0	[c]	19
50.0	51.5	[c]	3
[c]	18.0	[c]	[c]
86.2	82.8	18	-4
56.6	56.6	[c]	0
76.1	70.6	[c]	-7
21.5	21.5	-9	0
124.2	113.0	[c]	-9
86.7	76.8	[c]	-11
6.0	5.0	[c]	-17
323.1	327.1	14	1

(continued)

APPENDIX I

PROJECT NAME	F & E Years 1982-1992 1983
Sustain ARTCC/ACF Facilities	c
Sustain RMMS	c
System Safety and Efficiency Reviews	c
System Engineering and Integration (SEI) Contract	c
System Support Laboratory	c
System Support Laboratory Sustained Support	c
Technical Support Services	c
Test Equipment Modernization/Replacement	c
Subtotal - Maintenance and Operations Projects	$2,551.2
Project Subtotals	$11,551.0
Other Costs	
Development, Test, and Evaluation	142.8
Other Personnel and Installation Costs	c
Subtotal - Other Costs	$142.8
Total F&E Cost	$11,693.8

Cost Estimates Years 1982-2000		Percent change	
1990	1991	1983-1991	1990-1991
429.0	446.7	c	4
159.6	139.6	c	-13
c	c	c	c
772.3	772.3	c	0
32.5	31.5	c	-3
118.7	205.3	c	73
c	c	c	c
15.3	46.1	c	201
$8,727.7	$8,946.3	251	3
$29,466.1	$30,014.4	160	2
c	c	c	c
1,865.1	1,930.4	c	4
$1,865.1	$1,930.4	c	4
$31,331.2	$31,944.8	173	2

(continued)

APPENDIX II

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